Poster Exhibition Wednesday

29 - Integrating climate change, disturbances and diversity effects into growth models: from understanding

KG II - HS 2121 (Uni Freiburg)

IUFRO17-2176 **The role of large trees in the biomass production of heterogeneous forest**

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Abstract: In heterogeneous forests, large trees retain a substantial amount of above ground biomass, but their annual contribution to biomass accumulation remains unclear. A modal relationship between tree growth and tree size is traditionally expected. But recently, it has been demonstrated that the rate of tree biomass accumulation continuously increases with tree size supporting the metabolic theory of ecology. To clarify the role of large trees in biomass production of heterogeneous forest, we used data of tree growth, mortality and recruitment monitored during 20 years in 10×4-ha plots in a species rich and structurally complex tropical forest (Central African Republic). Biomass gains and losses were analyzed in relation to the abundance of large trees and by tree size classes using a bootstrap procedure. At the plot level, the accumulation of biomass in large trees was generally lower than that accumulated in small trees. The high mass growth rate of few large trees was therefore outbalanced by the growth of the numerous small trees. Moreover, the loss of biomass due to the mortality of few large trees could be substantial, and rarely outbalanced by the accumulation of biomass in these large trees. The annual net accumulation of biomass significantly decreases with the initial abundance of large trees.

Tree growth, heterogeneous forest, large trees

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IUFRO17-1068 **Unraveling soil effect on overyielding of species mixture in forests of the Netherlands**

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Abstract: A growing number of studies provide evidence that mixed-species forests often, but not always, have higher stand productivity than monospecific forests (referred to as overyielding). In this study, we explored how overyielding depends on the combination of mixed species and on soil fertility in Dutch forests. Firstly, we hypothesized that fast-growing species would dominate the stand and cause overyielding because the complementary resource use allows them to acquire soil resources more effectively and achieve more effective carbon gain at full exposure. Secondly, we expected that the complementary effects of the fast-growing dominant species and this overyielding would be stronger on more fertile soils. We evaluated our hypothesis by analysing five species Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), common beech (*Fagus sylvatica* L.), Scots pine (*Pinus sylvestris* L.), common oak (*Quercus robur* L.), and silver birch (*Betula pendula* Roth) growing in Douglas-fir-common beech, Scots pine-common oak, common oak-common beech, and common oak-silver birch mixtures from 398 permanent field plots all over the Netherlands. We found that two mixtures, i.e. Douglas-fir-common beech and Scots pine-common oak showed overyielding both on low and medium water availability and this overyielding was largely attributed to the admixture of Douglas-fir and common oak, respectively. The common oak-silver birch mixtures underyielded on low water availability and overyielded on medium water availability, whereas the common oak-common beech mixtures had no mixture effect. The results do not support our hypothesis since overyielding was not always driven by fast-growing species and also do not agree with the stress-gradient hypothesis because overyielding effect was similar on different soils. We conclude that the growth of one species benefits from the admixture species, and that soil water is not a factor limiting overyielding under the conditions as studied in the Netherlands.

Mixing effect; Soil water availability

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IUFRO17-648 **Disentangling species mixture effects on individual-tree growth using Swiss National Forest Inventory data**

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Abstract: Ecological processes driving the dynamics of forest ecosystems are greatly influenced by species diversity. In recent years, a lot of attention has been given to the comparison between mixed and monospecific stands, often showing a higher productivity in mixtures than in monocultures. However, mixing effects can vary strongly depending on climatic conditions, resource availability and stand development. Possible effects of tree species mixtures have rarely been considered in individual-tree growth models, which are pivotal tools for assessing forest development under environmental changes.
We used Swiss National Forest Inventory data to incorporate mixing effects into species-specific growth functions of the empirical scenario model MASSIMO. These functions include the influence of stand and tree characteristics, release effects due to harvesting, nitrogen, site topography and climate on tree growth. We integrated categorical predictors accounting for plot-level mixtures in the nonlinear mixed-effect models to analyze interactions between mixture and other predictors. In a second step, we implemented continuous variables such as species-level basal area of larger trees and stand density index, and assessed their predicative power to improve the models.
Although we detected positive influences of some categorical mixtures on tree growth, mixing effects for most species were observed to be negative. Often, these effects were significant only in interaction with other predictors, confirming the need to carefully account for stand density, climatic variation and soil resources when investigating complementarity. Continuous variables, however, corroborated the findings and improved the performance of the growth functions for most considered tree species, although their effect size varied among the species. The new functions will be implemented in the scenario model for better predicting forest development in response to changes in climate and species composition.

mixed forests; growth functions; species diversity

BOOK OF ABSTRACTS

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125TH ANNIVERSARY CONGRESS 2017

18 – 22 September 2017
Freiburg, Germany

IUFRO

www.iufro2017.com

125th IUFRO Anniversary Congress - Book of Abstracts, 2017. Freiburg. 724 p.

Published by Forstliche Versuchs- und Forschungsanstalt (FVA) Baden-Württemberg
ISBN 978-3-902762-88-7

The publication is available for download at:
https://www.iufro.org/events/anniversary-congress/#c24907